REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 63, 64, 66-69, 71-75, 77 and 78 are pending, with Claims 63, 68 and 74 amended by the present amendment.

In the Official Action, Claims 63, 66-68, and 71-73 were rejected under 35 U.S.C. §102(e) as being anticipated by Villareal et al. (U.S. Patent 6,850,548, hereinafter Villareal); and Claims 64, 69 and 75 were rejected under 35 U.S.C. §103(a) as being unpatentable over Villareal in view of Applicants' admitted prior art.

Claims 63, 68 and 74 are amended to more clearly describe and distinctly claim Applicants' invention. Support for this amendment is found in Applicants' originally filed specification.[1] No new matter is added.

Amended Claim 63 is directed to a semiconductor distributed Bragg reflector comprising a stacked structure of a first region and a second region, the second region being formed on the first region, the first region being hit with an incoming optical beam. Each of the first and second regions include an alternate stacking of first and second semiconductor layers having respective, different refractive indices; and a plurality of intermediate layers each sandwiched between a first semiconductor layer and a second semiconductor layer. The intermediate layer has a refractive index intermediate between the refractive indices of the first and second semiconductor layers. The intermediate layer is provided in the first region of the semiconductor distributed Bragg reflector having a thickness larger than the intermediate layer provided in the second region of the semiconductor distributed Bragg reflector. The first region has a lower doping concentration level as compared with the second region. Claims 68 and 74 are directed to alternative embodiments of Applicants'

[1] Specification, pages 349-408; Figures 132-149. For example, page 352, line 6 of Applicants' specification describes a layer thickness of 60 nm for an intermediate layer of region I while page 352, line 16 describes a layer thickness of 30 nm for an intermediate layer in region II.

invention, each reciting that the first region is closer to said active layer as compared with the second region; and that the first region has a lower doping concentration level as compared with the second region. With the invention recited in Claims 63, 68 and 74, it is possible to reduce a potential barrier height sufficiently by increasing a thickness of a compositional graded layer in a region I.[2]

Villareal describes an asymmetric distributed Bragg reflector (DDR) suitable for use in vertical cavity surface emitting lasers. The asymmetric DDR is comprises of stacked materials layers having different indexes of refraction that are joined using asymmetrical transition regions in which the transition steps within a transition region have different material compositions, different doping levels, and different layer thicknesses. Adjacent transition regions have different transition steps. Thinner transition regions are relatively highly doped and are located where the optical standing wave within the DDR has a low field strength. Thicker transition regions are relatively lightly doped and are located where the optical standing wave has a relatively high field strength.[3]

Column 5, line 50 through column 6, line 2 of Villareal, cited in the Official Action, refers to Figure 3 of Villareal and notes that the closest vertical line spacing occurs when the electric field is smallest (close to zero). This narrow spacing indicates the relatively small thicknesses of the layers that form an AlAs-to-GaAs junction. The layers that form the AlAs-to-GaAs junction have relatively high doping levels which decrease the electrical resistance across the transition region. However, because the electric field is low in that transition region, the optical absorption is also low, despite the high doping levels. Where the electric field is high, the vertical line spacing is relatively large, which represents relatively thick individual layers. This larger line spacing represents an interference junction where the GaAs composition changes to AlAs. That area is relatively lightly doped to help to decrease optical

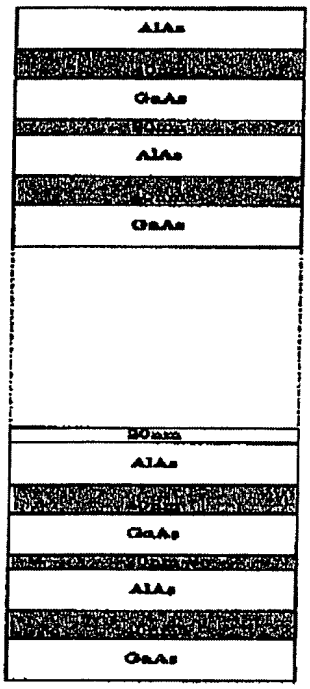
[2] Specification, page 354, line 22 through page 355, line 11.
[3] Villareal, column 3, lines 32-48..

absorption of the locally high electric field. The relatively large thicknesses of the transition region help to decrease electrical resistance without significantly increasing the optical absorption.[4]

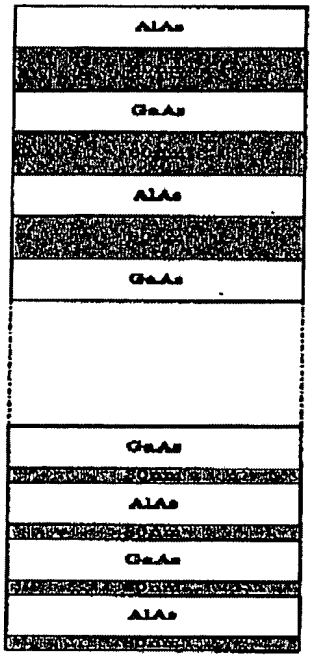
However, Villareal does not disclose or suggest a semiconductor distributed Bragg reflector where intermediate layers have different thicknesses and different doping concentrations and the thicknesses in doping concentrations are set in correspondence to the electric field strength of light within the semiconductor distributed Bragg reflector. In particular, Villareal does not disclose or suggest an intermediate layer provided in a first region of a semiconductor distributed Bragg reflector having a thickness larger than an intermediate layer provided in a second region of the semiconductor distributed Bragg reflector as recited in amended Claims 63, 68 and 74. Villareal also does not disclose or suggest Applicants' claimed first region closer to an active layer as compared with the second region as recited in amended Claims 68 and 74. Villareal only describes repeating the intermediate layers of two different thicknesses (20 nm/40 nm) alternatively throughout a distributed Bragg reflector. A comparison of the structures of Villareal and Applicants' claimed invention is shown below:

[4] Villareal column, line 50 through column 6, line 2.

Villareal



Present Invention



In addition to the foregoing, Claims 63, 68 and 74 recite the first region is doped with a doping concentration level lower than the second region. With this, it becomes possible to reduce the optical absorption loss caused by free carrier absorption and intra valence band absorption. Further, it should be noted that the present invention avoids the problem of increased electrical resistance associated with the use of the low doping concentration level for the first region, by increasing the thickness of the compositional graded layer such that the potential barrier is sufficiently smoothed. As a result, the present invention can provide a DBR of excellent optical and also electrical characteristics such as low optical absorption. Villareal does not disclose or suggest Applicants claimed first region which is doped with a doping concentration level lower than a second region.

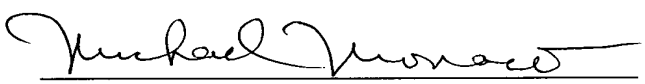
MPEP § 2131 notes that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d

1051, 1053 (Fed. Cir. 1987). See also MPEP § 2131.02. "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Because Villareal does not disclose or suggest all the features recited in Claims 63, 68 and 74, Villareal does not anticipate the invention recited in Claims 63, 68 and 74, and all claims depending therefrom.

Accordingly, in view of the present amendment and in light of the previous discussion, Applicants respectfully submit that the present application is in condition for allowance and respectfully request an early and favorable action to that effect.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



James J. Kulbaski
Attorney of Record
Registration No. 34,648

Michael E. Monaco
Registration No. 52,041

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 03/06)
MM/rac
I:\ATTY\MM\242058US-AM1.DOC